STATEMENT OF WORK

FIELD TESTS ON ALTERNATIVES TO BALLAST EXCHANGE

1.0 OBJECTIVE: The objective of this study is to test and investigate various alternatives to ballast water exchange at the pre-prototype stage. These tests are designed to determine the capability of the pre-prototype stages to kill or remove marine, brackish or fresh water organisms and micro-organisms including bacteria and other pathogens and should not be construed as a Pass or Fail test. Acceptance of any engineering performance does not mean approval by the U.S. Coast Guard nor does it set any standards for regulatory purposes.

2.0 BACKGROUND: In an effort to reduce the risk of introduction of nonindigenous marine species to waters of the United States, Congress enacted the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) (Pub. L. 101-646) on November 29, 1990. NANPCA contains specific provisions for controlling Aquatic Nuisance Species (ANS) and directly addresses the challenges of ballast water as a vector for exotic species. Included in NANPCA is a mandate that the U. S. Coast Guard promulgate regulations to prevent further ballast water introductions into the Great Lakes and Saint Lawrence Seaway.

On May 10, 1993, the resulting U.S. Coast Guard ballast water management regulations became effective for vessels traveling to the Great Lakes from beyond the Canadian or United states 200-mile-wide Exclusive Economic Zone (EEZ). These regulations mandate mid-ocean ballast water exchange as the current procedure to control the introduction of ANS to U.S. waters. It also stipulates that ballast water management practices should never compromise vessel safety.

On October 26, 1996, Congress enacted the National Invasive Species Act of 1996 (NISA) (Pub. L. 104-332), which amended and reauthorized NANPCA. NISA provides for ballast water management to prevent introductions and spread of ANS. It expands the scope of Coast Guard regulations to include all waters of the United States.

On February 3, 1999, President Clinton issued Executive Order 13112, "Invasive Species", which orders seven of its federal agencies to establish an Invasive Species Council in which all major stakeholders will be represented. The council will develop a cooperative strategy addressing escalated efforts to slow ANS invasions of American harbors. In August 2000, the council will submit an invasive species management plan that will focus on ballast water as one of many vectors of transport.

In compliance with NISA, the Coast Guard published an interim rule which became effective July 1, 1999, for all vessels that operate outside the EEZ and wish to enter U.S. waters. The rule amends existing regulations for vessels entering the Great Lakes or Saint Lawrence Seaway and provides voluntary ballast water management guidelines for vessels entering all other ports.

NISA also requires that the Coast Guard regulatory guidelines become mandatory after three years unless the maritime industry shows a high rate of compliance under a self-policing system. Therefore the interim rule establishes a ballast management reporting provision which will assist the Coast Guard in assessing compliance for the next two years.

Currently the main option in minimizing risk of ANS introductions is to exchange ballast water in areas outside the 200-mile-wide EEZ and in ocean depths greater than 2000 meters. Most ANS are either fresh water or brackish water organisms that cannot survive in high salinity environments found in the open ocean. Ballast exchange effectively eliminates ANS by 1) discharging a percentage of them into the inhospitable environment of the ocean and 2) by increasing the salinity level within the ballast tank to a level such that those remaining cannot survive.

While ballast exchange is an important stop-gap measure for reducing the probability that fresh or coastal species will be transported in ballast water, it has limitations which prevent it from serving as a long-term solution. In fact, there are no universally applicable options of ballast water management that can satisfy safety requirements, environmental acceptability, technical feasibility, practicality, ship design, and cost effectiveness.

Factors that affect vessel stability, such as heavy sea conditions, age of the vessel, and configuration of the ballast tanks may preclude some vessels from safely conducting ballast water exchange. Vessels fully laden with cargo but which contain only residual amounts of unpumpable ballast water are unable to conduct ballast exchange. They are considered as carrying no ballast on board (NOBOB) and are exempt from the present ballast exchange regulations. Yet the small amount of ballast water actually contained on board these NOBOB vessels is densely populated with ANS capable of invading U.S. waters. Apart from retrofitting vessels with prohibitively expensive equipment or retaining ballast aboard the ship, ballast exchange is the only feasible option at this time.

For the reasons listed above, the U.S. Coast Guard still considers ballast exchange an interim process and recognizes the present need to identify and develop an array of alternative ballast water management technologies that can be used to replace ballast exchange. Thus the U.S. Coast Guard is interested in testing various engineering devices to determine their capabilities and appraise their value for future use.

3.0 SCOPE: This study shall investigate the capability of specific engineering designs to kill or remove marine, brackish or fresh water aquatic organisms from ballast water under realistic field experimental conditions. The investigation shall focus on various filtering systems that have been or can be coupled with secondary processes such as ultraviolet or chemical induced procedures to kill small organisms, larvae, and bacteria. The designs shall be evaluated during treatment of large volumes of water

containing natural assemblages of organisms from natural bodies of water at the contractor's test site treated at high flow rates (1400-1500 U.S. gpm). The water for the tests shall be as close to natural as possible including turbidity at several levels and typical assemblages of organisms. Water shall be taken from and returned to natural bodies of water at the contractor's test site. Samples shall be taken in triplicate before filtering, after filtering and before secondary treatment and after secondary treatment to determine "percent kill" rate for each stage.

4.0 APPLICABLE DOCUMENTS: DOT Order 1700.18B, "Standards for the Preparation and Publication of DOT Scientific and Technical Reports"

5.0 REQUIREMENTS: The Contractor shall provide all personnel and engineering and technical services, as well as incidental materials necessary, to accomplish the following tasks:

5.1 TASK A: FILTRATION AND ULTRAVIOLET SECONDARY TREATMENT

5.1.1 Goal: Using an existing platform with a high suction lift pump (minimum of 1400 U.S. gpm with a preferred rate of 1500 U.S. gpm), filtration setup, and ultraviolet secondary treatment process, the Contractor shall conduct experiments to measure and verify the efficacy of pump, filter, and ultraviolet treatment killing or removing marine, brackish, and freshwater organisms and micro-organisms including bacteria and other pathogens. Water for the experiment shall be taken directly from and returned to natural bodies of water at the contractor's test site.

5.1.2 Description of Task: The Contractor shall set up necessary piping and sampling ports, conduct processing tests, obtain and analyze samples, and report results. Specific tasks include:

1) Provide platform, pump, filtration, and secondary UV treatment device with appropriate piping to allow withdrawal of representative water samples.

2) Obtain, process, and analyze triplicate samples as defined below:

a) Obtain samples prior to filtering, after filtering and before secondary treatment, and after secondary treatment

b) Obtain and analyze triplicate samples taken at flow rates of 1400 - 1500 U.S. gpm and filter size of 40 - 50 microns.

c) Obtain and analyze samples at 3 turbidities (Low - ambient natural water; Medium - ambient natural water with induced, slightly raised turbidity; High - ambient natural water with induced, greatly raised turbidity). Contractor shall increase turbidity in accordance with Army Corps of Engineers permits.

d) Samples shall be taken for analysis immediately after experimental run and 18 hours after experimental run to study long term effects of treatment.

3) Analyze samples to determine presence/absence of species as well as an estimate of viability. Analysis should include amount of biological organisms removed or killed at each stage of treatment.
4) Analyze sample data to determine efficacy of filter and secondary UV treatment and the effect of turbidity.

5.2 TASK B: CYCLONIC FILTRATION AND ULTRAVIOLET SECONDARY TREATMENT

5.2.1 Goal: Using the same platform and high lift pump used in Task A, the Contractor shall conduct similar experiments using a hydrocyclonic filtration system with ultraviolet secondary treatment to measure and verify the efficacy of pump, hydrocyclonic filtration, and ultraviolet treatment in killing or removing marine, brackish, and freshwater organisms and micro-organisms including bacteria and other pathogens. Water for the experiment shall be taken directly from and returned to natural bodies of water at the contractor's test site.

5.2.2 Description of Task: The Contractor shall set up necessary piping and sampling ports, conduct processing tests, obtain and analyze samples, and report results. Specific tasks include:

1) Provide platform, pump, piping with sampling ports, and catchment reservoirs for experiments.
2) Provide for hydrocyclonic filtration apparatus and secondary UV module to be tested. Contractor shall make arrangements with manufacturer or agent for such equipment.
3) Load and assist with set up hydrocyclonic filtration apparatus and UV module
4) Obtain, process, and analyze triplicate samples as defined below:
   a) Obtain samples prior to filtering, after filtering and before secondary treatment, and after secondary treatment
   b) Obtain and analyze triplicate samples taken at flow rates of 1400 - 1500 U.S. gpm through hydrocyclonic filtration unit.
   c) Obtain and analyze samples at 3 turbidities (Low - ambient natural water; Medium - ambient natural water with induced, slightly raised turbidity; High - ambient natural water with induced, greatly raised turbidity). Contractor shall increase turbidity in accordance with Army Corps of Engineers permits.
   d) Samples shall be taken for analysis immediately after experimental run and 18 hours after experimental run to study long term effects of treatment.
5) Analyze samples to determine amount of biological organisms removed or killed. Analysis should include presence/absence as well as viability of organisms tested. Size category of organisms is also desired.

6) Analyze sample data to determine efficacy of hydrocyclonic filter and UV treatment.

6.0 Deliverables - Draft and Final Reports: The final report shall discuss tests and results obtained during Tasks A and B. The report shall address work accomplished, data acquired, conclusions drawn, and shall provide comparison of results of turbidity on treatments tested and comparison of standard filtration vice hydrocyclonic filtration. The draft final report and final report will be reviewed by the U.S. Coast Guard and be completed as a technical report under the National Technical Information Service (NTIS) guidelines. The contractor shall follow DOT Order 1700.18B, "Standards for the Preparation and Publication of DOT Scientific and Technical Reports," in preparing the manuscript. The report shall be prepared using Microsoft Office for Windows NT 4.0 compatible software.

6.1 Contractor shall provide an interim report of findings of Tasks A and B. (Deliverable 1).

6.2 Contractor shall provide a final report of Tasks A and B. Final report shall discuss results of Tasks A and B and shall compare results of all tests. (Deliverable 2).

7.0 Contractor Requirements

7.1 Permits: Contractor shall obtain all necessary permits relating to increasing turbidity in and discharging increased turbidity water into natural water source. Contractor shall at all times be in compliance with permits and other applicable local, state, and federal regulations.

7.2 Safety: Contractor must comply with all federal, state, and local safety regulations at site. Platform must meet all safety standards.

7.3 Experimental Equipment: Contractor shall make all arrangements for use of hydrocyclonic filtration unit and secondary UV unit.

7.4 Pump: Contractor's equipment must be capable of pumping water at flow rates of at least 1400 U.S. gpm with a preferred rate of 1500 U.S. gpm. Water for the experiment shall be taken directly from and returned to natural bodies of water at the contractor's test site.

8.0 Supporting Information

8.1 Progress Reports: Contractor shall maintain communication with U. S. Coast Guard Research and Development Center throughout project via telephone and e-mail.

8.2 Period of Performance:

8.2.1 Field tests shall be performed between May 1, 2000 and November 1, 2000.

8.2.2 Interim report is due February 2, 2001

8.2.3 Draft final report is due May 1, 2001

8.2.4 Final report is due July 1, 2001

Deliverable: No.1

Title: Field Tests on Alternatives to Ballast Exchange, Interim Report

SOW Reference(s): 6.0, 6.1

Reference/Guidance Documents: DOT Order 1700.18B, "Standards for the Preparation and Publication of DOT Scientific and Technical Reports"

Submission / Distribution

Contractor shall submit interim report discussing tests and preliminary results obtained during Tasks A and B.

Copies:	Deliver to	No.	Format	Date Due
Interim Report	COTR	2	Paper	February 2, 2001

Deliverable: No. 2

Title: Field Tests on Alternatives to Ballast Exchange, Final Report

SOW Reference(s): 6.0, 6.2

Reference Guidance Documents: DOT Order 1700.18B, "Standards for the Preparation and Publication of DOT Scientific and Technical Reports"

Submission/Distribution

Contractor shall submit final report discussing tests and results obtained during Tasks A and B. Report shall provide comparison of results of turbidity on treatments tested and comparison of standard filtration vice hydrocyclonic filtration.

Copies:	Deliver to	No.	Format	Date Due
Draft Final Report	COTR	2	Paper	May 1, 2001
Final Report	COTR	3	Paper	July 1, 2001
Final Report	COTR	1	Electronic, MS Office for Windows NT 4.0 compatible (3.5 inch double sided, high density floppy diskette)	